

**The claims defining the invention are as follows:**

1. An apparatus for rendering an object-based image one pixel at a time in scanline order, the apparatus comprising:
  - 5 an optimisation module for minimising a number of compositing messages for compositing the object-based image, the optimisation module comprising:
    - a first unit for setting, for a first pixel in a run of pixels between adjacent edges of objects, first data in one or more compositing messages of a sequence of compositing messages to indicate a compositing result of the one or more compositing messages is to be  
10 stored for use in compositing of each pixel subsequent to the first pixel in the run of pixels; and
    - a second unit for generating, for each pixel subsequent to the first pixel in the run of pixels, a reduced set of compositing messages from the sequence of compositing messages, the second unit comprising:
      - 15 a sub-unit for generating, for each pixel subsequent to the first pixel in the run of pixels, the reduced set of compositing messages; and
      - a sub-unit for setting, for each pixel subsequent to the first pixel in the run of pixels, second data in one or more compositing messages of the reduced set to indicate the stored compositing result is to be retrieved for use in compositing of each pixel subsequent to  
20 the first pixel in the run of pixels; and
    - a compositing module for generating a resultant color and opacity for a currently scanned pixel in accordance with the compositing messages, wherein the compositing module generates the color and opacity of the first pixel in the run of pixels in accordance with the sequence of compositing operations, and the compositing module generates the color  
25 and opacity of each pixel in the run subsequent to the first pixel in accordance with the reduced set and the retrieved compositing result.

2. The apparatus as claimed in claim 1, wherein the compositing module comprises a stack for generating a resultant color and opacity for a currently scanned pixel in accordance with the compositing messages.
- 5 3. The apparatus as claimed in claim 2, wherein each compositing message comprises compositing instructions, data representative of the color and opacity of an associated object, and data representative of whether the color and opacity is constant along the scanline.
4. The apparatus as claimed in claim 3, wherein the first unit comprises:  
10 a sub-unit for setting the first data of a current compositing message in the event a predicted stack depth of the stack is of a predetermined depth and the current compositing message and all of the compositing messages having their associated first data set so far are associated with objects that have a constant color and opacity along the scanline.
- 15 5. The apparatus as claimed in claim 4, wherein the reduced set of compositing messages comprises the compositing message corresponding to the last compositing message of the first pixel having the first data set and the subsequent compositing messages of the sequence corresponding to the compositing messages having their first data not set.
- 20 6. The apparatus as claimed in claim 5, wherein the sub-unit for setting the second data in the one or more compositing messages of the reduced set comprises:  
a sub-unit for setting the second data in the compositing message corresponding to a last compositing message of the first pixel having the first data set.
- 25 7. The apparatus as claimed in claim 3, wherein the compositing instructions comprise stack operations and color and opacity operators, and wherein the first unit comprises:  
a sub-unit for setting the first data of a current compositing message in the event the current compositing message and the compositing messages having their first data set so far

are associated with objects that have a constant color and opacity over the scanline and comprise stack operators that are not a predetermined stack operator.

8. The apparatus as claimed in claim 2, wherein the compositing result is a value on the top of the stack.
9. The apparatus as claimed in claim 2, wherein the first data indicates that the state of the stack storing the compositing result is to be stored.
10. The apparatus as claimed in claim 9, wherein the first unit comprises:  
a sub-unit for setting the first data of a current compositing message in the event the current compositing message is the first compositing message for the first pixel in the run associated with objects that have a variable color and opacity along the scanline.
11. The apparatus as claimed in claim 10, wherein the reduced set of compositing messages comprises the compositing message corresponding to a last compositing message of the first pixel having the first data set and the subsequent compositing messages of the sequence corresponding to those compositing messages having their first data not set.
12. The apparatus as claimed in claim 11, wherein the sub-unit for setting the second data in the one or more compositing messages of the reduced set comprises:  
a sub-unit for setting the second data in the compositing message corresponding to a last compositing message having the first data set.
13. The apparatus as claimed in claim 3, wherein the first unit comprises:  
a sub-unit for setting the first data of a current compositing message in the event the current compositing message is associated with a predicted stack depth of a predetermined

value and is one of a sub-sequence of compositing messages that have a constant color and opacity along the scanline and comprise a color and alpha operator of a predetermined type.

14. The apparatus as claimed in claim 13, wherein the color and alpha operator of a  
5 predetermined type is associative.

15. The apparatus as claimed in claim 14, wherein the sub-unit for setting the first data in  
addition sets the first data of a current compositing message in the event the current  
compositing message is associated with a predicted stack depth of a predetermined value and  
10 has a stack operator, and color and alpha operators of a predetermined type.

16. The apparatus as claimed in claim 14, wherein the reduced set of compositing  
messages comprises:

the compositing messages of the sequence that are not members of the sub-sequence  
15 and correspond to those compositing messages of the first pixel having their first data not set;  
and

the compositing message corresponding to a last compositing message of the first  
pixel having the first data set.

20 17. The apparatus as claimed in claim 13, wherein the sub-unit for setting the second data  
in the one or more compositing messages of the reduced set comprises:

a sub-unit for setting the second data in the compositing message corresponding to a  
last compositing message having the first data set.

25 18. The apparatus as claimed in claim 3, wherein the first unit comprises:

a sub-unit for setting the first data of a current compositing message in the event the  
current compositing message is associated with a predicted stack depth of a predetermined

value and is one of a sub-sequence of compositing messages that have a constant color and opacity along the scanline and are part of a valid branch of an expression tree.

19. The apparatus as claimed in claim 18, wherein the reduced set of compositing  
5 messages comprises;

the compositing message corresponding to a last compositing message having the first data set, for each predicted stack depth for which first data has been set for at least one compositing message; and

10 the compositing messages of the sequence corresponding to those compositing messages having their first data not set and subsequent to the last compositing message having the first data set..

20. The apparatus as claimed in claim 18, wherein the sub-unit for setting the second data in the one or more compositing messages of the reduced set comprises:

15 a sub-unit for setting the second data in the compositing message corresponding to a last compositing message having the first data set, for each stack depth for which first data has been set for at least one compositing message.

21. A method for rendering an object-based image one pixel at a time in scanline order,  
20 the method comprising the steps of:

an optimisation step for minimising a number of compositing messages for compositing the object-based image, the optimisation step comprising the sub-steps:

a setting step for setting, for a first pixel in a run of pixels between adjacent edges of objects, first data in one or more compositing messages of a sequence of compositing  
25 messages to indicate a compositing result of these one or more compositing messages is to be stored for use in compositing of each pixel subsequent to the first pixel in the run of pixels; and

a generating step for generating, for each pixel subsequent to the first pixel in the run of pixels, a reduced set of compositing messages from the sequence of compositing messages, the generating step comprising:

5 a generating sub-step for generating, for each pixel subsequent to the first pixel in the run of pixels, the reduced set of compositing messages; and

a setting sub-step for setting, for each pixel subsequent to the first pixel in the run of pixels, second data in one or more compositing messages of the reduced set to indicate the stored compositing result is to be retrieved for use in compositing of each pixel subsequent to the first pixel in the run of pixels; and

10 a compositing step for generating a resultant color and opacity for a currently scanned pixel in accordance with the compositing messages, wherein the compositing module generates the color and opacity of the first pixel in the run of pixels in accordance with the sequence of compositing operations, and the compositing module generates the color and opacity of each pixel in the run subsequent to the first pixel in accordance with the reduced  
15 set and the retrieved compositing result.

22. A computer program product comprising machine-readable program code recorded on a machine-readable recording medium, for controlling the operation of a data processing apparatus on which the program code executes to perform a method for rendering an object-  
20 based image one pixel at a time in scanline order, the method comprising:

an optimisation step for minimising a number of compositing messages for compositing the object-based image, the optimisation step comprising the sub-steps:

a setting step for setting, for a first pixel in a run of pixels between adjacent edges of objects, first data in one or more compositing messages of a sequence of compositing  
25 messages to indicate a compositing result of these one or more compositing messages is to be stored for use in compositing of each pixel subsequent to the first pixel in the run of pixels; and

a generating step for generating, for each pixel subsequent to the first pixel in the run of pixels, a reduced set of compositing messages from the sequence of compositing messages, the generating step comprising:

5 a generating sub-step for generating, for each pixel subsequent to the first pixel in the run of pixels, the reduced set of compositing messages; and

a setting sub-step for setting, for each pixel subsequent to the first pixel in the run of pixels, second data in one or more compositing messages of the reduced set to indicate the stored compositing result is to be retrieved for use in compositing of each pixel subsequent to the first pixel in the run of pixels; and

10 a compositing step for generating a resultant color and opacity for a currently scanned pixel in accordance with the compositing messages, wherein the compositing module generates the color and opacity of the first pixel in the run of pixels in accordance with the sequence of compositing operations, and the compositing module generates the color and opacity of each pixel in the run subsequent to the first pixel in accordance with the reduced  
15 set and the retrieved compositing result.